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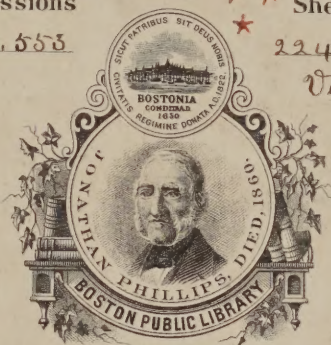


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1880.



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THE
HUNDRED GREATEST MEN
PORTRAITS

OF THE
ONE HUNDRED GREATEST MEN OF HISTORY

REPRODUCED FROM FINE AND RARE ENGRAVINGS

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Vol. 8.
1880.

VOLUME VIII

Industry

INVENTORS, DISCOVERERS, PHILANTHROPISTS

WITH AN INTRODUCTION

BY PROFESSOR JOHN FISKE

LONDON
SAMPSON LOW, MARSTON, SEARLE, AND RIVINGTON
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INTRODUCTION TO VOLUME VIII.

INVENTORS AND DISCOVERERS

LAST of all, in our gallery of heroes, come the heroes of industrial civilisation—the bold explorers who have enlarged the area of the civilised world, and the men who by inventive genius have added to the number and complexity of the processes whereby human wants are satisfied. In one sense it was doubtless well to place this group of heroes last; for, while the groups of greatest poets and founders of religions carry us back into an almost mythical antiquity; and while art, philosophy, history, science and politics have each and all of them their illustrious representatives in ancient as well as in modern times; on the other hand, we find that all the discoverers and inventors who have been thought worthy to be included among the hundred greatest men of history, belong to modern times. Nor is this curious circumstance merely an accident; on the contrary, it affords an apt illustration of one of the most striking and important of all the general aspects of the history of civilisation. It is not true that industrial art is later in its beginnings than the arts of warfare and statesmanship, or than the inclination toward scientific inquiry. In their most rudimentary beginnings all these things were, no doubt, nearly simultaneous with each other, as well as with art, religion and poetry. Pre-glacial men scratched outline pictures of reindeer on their crude stone hammers; the first man who explained an eclipse as the swallowing of the sun by a dragon, propounded an hypothesis of the kind by which the beginnings of science and of theology are alike characterised; and poetry and music had their humble origin in tales about the dead hero, and rhythmical chants and dances in

propitiation of his ghost. And in like manner the ingenious savage of primeval times who first discovered that it was easier and safer to float across a river on a log, if you hollowed out the log, was the legitimate precursor of Fulton and Ericsson. But the names of the clever men who invented canoes and bows and arrows are as utterly unknown to tradition as the names of the earliest myth-makers, or of those pre-Homeric heroes who won for the Aryan people the rich heritage of the southern peninsulas of Europe. It was only after civilisation had already made considerable progress, after tribes of men had become united into large and stable political aggregates, and after the business of society had acquired a rather high degree of complexity, that individual men could achieve work of any sort on a sufficiently grand scale to arrest the attention of succeeding generations through thousands of years. Granting that some pre-Homeric hero may have had the native powers of a Hannibal, the fact that his achievements did not visibly affect great masses of society, but only the movements of a few petty tribes, would be enough to prevent his fame surviving, save, perhaps, in some vague, half-intelligible legends about giants and demi-gods. But after the historical period, in the long career of nascent humanity, had fairly begun—after great societies had been formed, with generals and statesmen, poets and artists, and even philosophers—a long time had still to elapse before anything was heard of inventors of giant calibre and wonderful achievements like Arkwright and Watt. And this fact has in history a marked significance.

Before inventors of this sort were possible, it was necessary, in the first place, that society should have reached a state of comparative stability politically. The ages which witnessed the exploits of a Belisarius, a Pepin, or a Godfrey de Bouillon, were ages in which neither a Columbus nor a Gutenberg was possible. Amid such chronic political turmoil, there was no surplus energy which could be devoted to the exploration and colonisation of remote countries, nor was there enough security for industry at home to permit the adoption of new devices for facilitating industrial processes. In the second place, it was necessary both that commercial operations should have begun to cover a wide geographical range, and that the physical sciences should have made considerable progress. The application of both these considerations to the case of a discoverer like Columbus, is obvious enough ; but both are equally applicable to the case of such an inventor as

Arkwright. Supposing that such a man could have been produced, and could have invented his spinning machine in the age of Augustus or of Trajan, no such results would have followed as were brought about a hundred years ago in England. The general knowledge of machinery was insufficient, and the general extension of commerce was also insufficient. And so it follows, in the third place, that when men of the intellectual calibre of Watt and Arkwright were born in such a state of society as that of ancient Rome, their attention was turned to other things, and not to the mechanical arts; they became statesmen or lawyers, poets or philosophers, but not inventors on a grand scale. There was no lack of inventive talent on the part of the ancients, especially as applied to processes of warfare, as was illustrated by the skilful devices with which the Romans, in the first Punic War, wrought such wholesale destruction on the Carthaginian fleets. But the men who devised these remarkable engines, though they effected a temporary purpose, accomplished nothing toward extending permanently the control of mankind over the forces of nature, or toward modifying the career of industry; and so they are not remembered among the great inventors. The explanation of the non-appearance of Watts and Arkwrights in ancient times is not to be found, therefore, in any assumed lack of inventive talent, but in the social conditions which prevailed in antiquity and down to the close of the Middle Ages.

But there is a still more striking historic significance in the relatively late appearance of the heroes of industry. The paucity of inventors in antiquity, and their increasing frequency in modern times, serves as the index of a great change that has been slowly taking place in the prevailing character of human activity. Whereas the basis of civilisation was once mainly military, it has now become mainly industrial. Whereas the occupation of the greater part of mankind was once fighting and pillage, it is now the peaceful cultivation of the earth and the transformation of the earth's various productions into endlessly complex instruments for satisfying human wants, both physical and æsthetic. Warfare has long been necessary for the purpose of securing and maintaining the political stability of great masses of men, without which industry itself could not attain to any high development. From this point of view, warfare has not yet ceased to be necessary, especially where civilised societies are molested or threatened by barbarous societies, and no doubt it will be a long time before warfare

becomes extinct ; but, in spite of this, the sphere of warfare in modern life has become very much restricted. In such countries as England and the United States, it takes up the time and attention of only a very small part of the community, and only at considerable intervals acts as a real disturbance to the prevailing occupations, which are almost entirely concerned, directly or indirectly, with industry. The enormous complication of modern society, which has been mainly brought about by the labours of industrial discoverers and inventors, in co-operation with scientific inquirers, has brought things to such a pass that men engage more and more unwillingly in warfare, and regard it more and more as an intolerable source of disturbance. And along with the diminution of the quantity of warfare, and the restriction of its sphere, there has gone on a gradual alteration in the feelings and in the manners of civilised men. This change has been shown in increased regard for domestic comfort, in the abolition of judicial torture and of cruel modes of punishment, in prison reforms, and generally in increased softness of temper and mildness of manner. That this change is due to the general substitution of industrial for military activity, is too obvious to require detailed argument ; yet, when duly considered in all its bearings, the connection of this change with human happiness will be found to be so close that, even had nothing else been accomplished by the inauguration of the industrial era, we should still have ample ground for regarding the great discoverers and inventors as among the chief benefactors of mankind. Though last in order, we can in no wise rank them as least in noble desert.

JOHN FISKE.

LIST OF PORTRAITS

IN THE

EIGHTH VOLUME



GUTENBERG

COLUMBUS

PALISSY

FRANKLIN

MONTGOLFIER

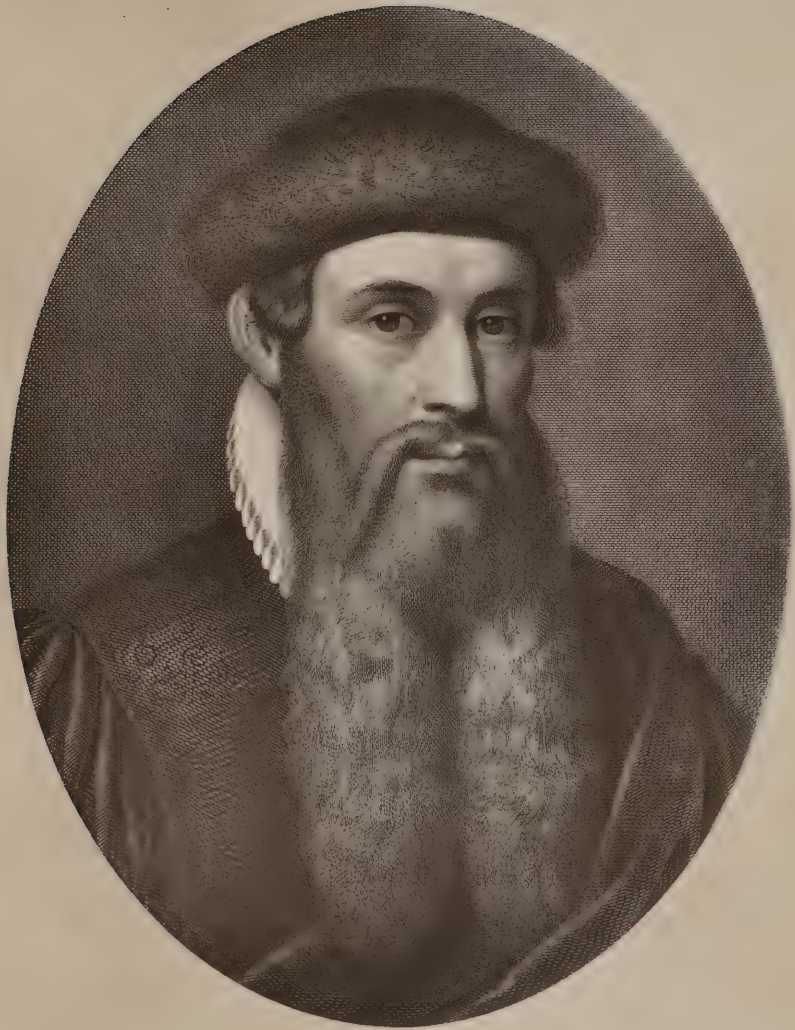
HOWARD

ARKWRIGHT

WATT

STEPHENSON





Boston Public Library,

GUTENBERG

GUTENBERG

1400-1468

MACHINERY

INVENTION OF PRINTING

FOREMOST among our modern engines stands the press, and among all our heroes of modern industry the inventor of printing stands in the foremost rank. Gutenberg was born at Mayence in 1400 of a noble family, his true name being Hans Geinfleisch de Sulgeloek. The name under which he is universally known was that of his mother's family, adopted by him on account of the political troubles of his time. In 1420, a disturbance occurring at Mayence immediately succeeding the entrance of the Emperor Frederick III., the young nobleman was forced to quit his native city, and it is generally believed that he went immediately to Strasbourg; at least he was in that city in 1434, and two years later formed a partnership for the working out of certain *secret processes* invented by him, among which must have been nothing less than the art of printing, in embryo. Five years later he was involved in a lawsuit, the papers of which are now carefully preserved in Strasbourg. These are the earliest documents relative to the art of printing. It was in 1439, at Strasbourg, that judgment was pronounced upon the subject of the working out of the *secret process* invented

by Gutenberg. His associates, it appears, had been Andrew Dritzchen, of noble birth like himself, and who, like him, compromised his social position by being occupied in industrial pursuits, but a man full of enthusiasm, as were the other partners, Hans Riffe and Andrew Heilmann, all of Strasbourg. In the abandoned convent of St. Arbogaste the first attempt had been made, and the works had been executed with the greatest secrecy. There is a mention of materials and utensils, of lead, of a press, of a vice for holding the parts together, &c., and that the work should be ready for the coming fair at Aix-la-Chapelle. The wording is anything but clear, the aim seeming to be to avoid revealing to the public anything of which it ought to remain ignorant. At that epoch all industry surrounded itself with secrecy.

About 1446 he returned to Mayence, and permanently located himself there. The great expense involved in his undertakings had consumed all his means, and in 1450 he formed a new partnership with the rich goldsmith Faust, for the further exploitation of his admirable invention, and acquainted him with the results already obtained. Faust made the necessary advances, but later on introduced a third, Schaeffer, as partner or employé, and took such guarantees for the money advanced, that five years after he was able to break the connection by demanding of Gutenberg a reimbursement. The latter, unable to satisfy his demands, was forced to hand over to him his apparatus and nearly all his stock.

After the break in partnership Faust and Schaeffer continued to print, and Gutenberg, on his side, succeeded in again establishing himself in the same city, where he brought out the first printed Bible, the famous Bible of Thirty-Six Lines, begun long before with other partners at Strasbourg.

His last years were passed obscurely in the midst of hard work, and unhappily in the embarrassments of poverty. In 1465 Adolphe of Nassau named him Gentleman of the Court, and gave him a small pension. Three years after this occurred his death. Nothing is known of his private life. That he married appears from the fact, that in 1437 a complaint was entered against him at Strasbourg by a lady of rank, claiming the fulfilment of a promise of marriage, and later her name is identified with his in the register.

The obscurity which envelopes the early epoch of the history of

printing is rendered more cloudy still by the precautions which the inventor and his partners took to conceal their proceedings. Their books were sold at the same high price as those executed by hand, and the rapidity with which he produced them gave rise to grave suspicions among the authorities. It was ascribed to magic, and Mephistopheles, rather than either Faust or Gutenberg, got the credit of the invention.

Still greater uncertainty exists in regard to the steps by which Gutenberg arrived at his invention. It is believed that he first printed a little vocabulary called *Catholicon*, and a *Donatus Minor*, on fixed wooden blocks; that he afterwards employed movable wooden characters, and at last found out a way to cast these characters in metal, a process afterwards perfected by Schaeffer. But it will always be difficult, perhaps impossible, to determine exactly what belongs to Gutenberg, and what to others, in the labours of so many years at Strasbourg and Mayence; labours which at last brought the typographical art up to that point of perfection shown in the 'Letters of Indulgence,' and the 'Bibles' which appeared in 1454. According to Didot, Gutenberg, in his work, probably traversed the following phases : 1. The engraving of movable letters, first in wood, then in lead, and the adjusting more or less regularly these letters for the impression. 2. The casting of the letters, clay lead or tin, by means of moulds in sand. 3. The retouching of these characters after the casting—*sculpto-fusi*. 4. The engraving of the letters on soft steel, tempering it afterwards, and striking these letters in matrices of copper. 5. Moulds, of which the mechanism was probably at first similar to that the ancients employed in making medallions, and which were afterward perfected by Schaeffer. 6. The composition of a siccative ink, and the preparation of leather pads by which to extend the ink over the characters. 7. The press, chief of all, the embodiment of the whole process, of which it terminates the different operations. The imagination, vividly excited in seeing for the first time entire sheets written by a single stroke of the press, as by a miracle, recognises in this Gutenberg a mighty magician; but let into the secret by the contemplation of all these tedious stages of preparation for the final result, the reason is tempted to pronounce him a practical mechanic. De Sulgeloek the nobleman becomes Gutenberg the inventor, the age of Chivalry is transformed into the age of Industry.

The inscription at the end of the *Catholicon* of Janua, one of the most

important of the works which he printed, is a sort of pious hymn in honour of the discovery of printing, and has often been cited in his praise. It commences by acts of grace, which Gutenberg, from a heart full of gratitude, renders to God and the Holy Trinity; then it declares that the execution of his book is due to the supreme direction of Him who, by a sign, renders eloquent the voices of His children, and who often reveals to the least among them that which He conceals from the most profound. "It was," adds the inscription, "in the year of the Incarnation, 1460, that this remarkable book appeared at Mayence, that celebrated city of Germany, on which the Divine clemency deigns to descend to make it shine among all the nations. It is not by the aid of the pen, the style, or the calamus, that this book has been written, but by the admirable accord of stamp and matrice, and their proportion and module."

The following are the first books printed by Gutenberg, and consequently the first ever issued from the press.

1. A small vocabulary called 'Catholicon,' printed probably at Strásbourg.

2. One or many editions of the 'Donatus Minor,' printed at Strásbourg.

3. The 'Letters of Indulgence,' 1454-1455.

4. The 'Calendar' for 1457, printed in the type of the 'Bible of Thirty-Six Lines.'

5. The 'Appeal against the Turks,' which appeared in 1454, and forms six leaves in quarto.

6. The 'Bible of Thirty-Six Lines,' 3 vols. in folio, printed perhaps at Strásbourg.

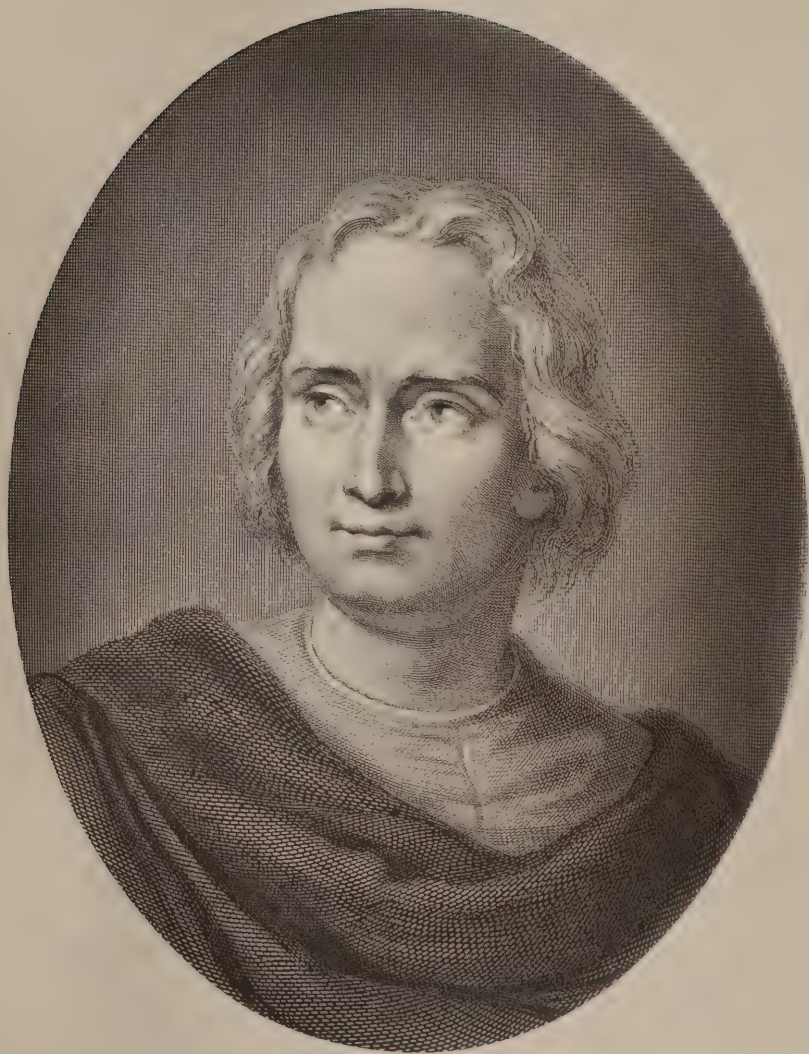
7. The 'Psalter of Mayence.'

G U T E N B E R G

CHRONOLOGY OF HIS LIFE



1400	BORN AT MAYENCE.		
1424	AT STRASBURG	AGE	24
1443	RETURNED TO MAYENCE	„	43
1449	ENTERED INTO PARTNERSHIP WITH JOHANN FAUST	„	49
1455	PARTNERSHIP DISSOLVED	„	55
1468	DIED AT MAYENCE	„	68



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COLUMBUS

COLUMBUS

1436-1506

VOYAGES

DISCOVERY OF AMERICA

COLUMBUS was an Italian, born at Genoa about 1436. His father came of an ancient family of Plaisance, and was a wool-carder or weaver. Christopher, who felt no disposition for this peaceful occupation, embraced, at the age of fourteen, the more adventurous calling of a sailor, after having studied for some time, at the University of Pavia, "geography, cosmography, geometry, astronomy, and the nautical sciences." The details of the history of his youth, of his adventures at sea, and of his studies and projects, are rather meagre; but it is known that he sailed in all the Mediterranean regions, and probably in some latitudes of the Ocean.

In 1470 we find him at Lisbon, where he married the daughter of a skilful navigator, Palestrello, who had founded a colony in the Island of Porto Santo, and whose manuscripts, instruments, and observations Columbus fell heir to. It appears that after his marriage Columbus resided some time at Porto Santo, and took part in some expeditions to the coasts of Guinea. In 1477 he made a voyage to the Northern Ocean, to verify the discoveries attributed to the Scandinavian navigators of the Middle Ages. It is certain that even then his vast project was shaping

itself in his mind. His studies and voyages, the reading of the ancients, and meditations on the vague traditions of a great continent beyond the Pillars of Hercules, the conjectures of the Greeks on the shape of the earth, the diverse notions received from the voyage of Marco Polo, the remains of unknown vegetable matter thrown on the shores of Porto Santo, had all conduced to make him entertain the possibility of gaining the shores of Asia by navigating to the West. His one idea was to find a new route by which to arrive more speedily at the country of spices, gold, and elephants, that is, India or China. As the idea developed, Columbus entered into correspondence with the geographer Toscanelli, of Florence, who, like himself, believed in a possible route to India toward the setting sun.

With plans matured, and prepared to defend his cherished scheme, he laid it before John II. of Portugal, after his own countrymen, the Genoese, had refused to aid him. Taking advantage of his charts and detailed plans, John II. tried to rob Columbus of the glory of the project by privately dispatching a fleet on the indicated route. But a tempest sent them back alarmed and disabled, and the scheme was declared chimerical and extravagant. Indignant at this treatment, the Genoese navigator turned in 1485 towards Spain, then engaged in war against the Moors. He gained a partial hearing, and then began for him that period of unsuccessful solicitation when, hanging about the court and camp of Ferdinand and Isabella, his hopes were sometimes raised to the point of seeming fulfilment, but often he became so discouraged as to seriously think of applying elsewhere for aid. He was obliged to defend his opinion of the rotundity of the earth and the possibility of making a voyage around it before the College of Salamanca, composed of the most learned professors of astronomy, geography, and mathematics, and the most eminent dignitaries of the Church. Despised, rebuffed, railed at, obliged to live by the sale of maps and charts which he made, Columbus never lost faith in the final triumph of his idea, though in 1490, after three years' discussion, the scheme was decided by the learned college to be impracticable.

Battling with a manly constancy against the prejudices of his contemporaries, he gained, some time afterwards, new protectors, who stood near the throne. Yet a fresh series of trials awaited him, and it was not till the taking of Granada, about eight years after his first petition, that a sudden

inspiration of Isabella permitted him to realize his dream. At the very threshold of the enterprise, however, the negotiations were nearly broken off by the businesslike demands of Columbus, who insisted on a tenth of all profits, with the title and office of viceroy of all dominions discovered by him. This being at first refused, the obstinate Italian mounted his mule, and had well-nigh departed for France, when the Court thought better of it; he was recalled, and an arrangement effected. The following is a copy of the contract between Columbus and the Spanish sovereigns:—
“Columbus to be made admiral of the seas and countries he is about to discover; to hold this dignity during life and it shall descend to his heirs. Columbus to be made viceroy of all the continents and islands. To have a share amounting to a tenth part of the profits of all merchandise, pearls, jewels, or other things that may be found, gained, bought, or exported from the countries. Columbus to be sole judge of all mercantile matters that may be occasions of dispute in said countries. To have the further right to contribute an eighth part of the expenses of all ships which traffic with the new countries, and in return to receive an eighth part of the profits. Santa Fé, Granada, April 17, 1492.”

Columbus set out from Palos in August, with three small vessels and one hundred and twenty men. He sailed boldly toward the West. The journal of this first voyage has been given in an abridged form by his friend Las-Casas, author of the ‘History of the Indies.’ It is a veritable marine epic, and gives a faithful picture of the bold expedition, the indomitable faith of the navigator, whom no delays or variation of the compass could affect, and of his energetic constancy and prudence in the midst of seamen a hundred times deceived by false appearances of approaching land, and, who undeceived, were on the point of mutiny.

Seventy days’ sailing westward had been accomplished, and then the welcome land appeared in sight, being, not as Columbus supposed, the shores of India, but an island named by him San Salvador, and called by the natives Guanahani. Afterwards he sighted Cuba and Hayti. On the latter he left a few men in garrison, and returned to Europe, the ships laden with curiosities from this new world. He was received with universal enthusiasm. Ferdinand and Isabella confirmed to him the titles of admiral and viceroy, with the privileges he had had the foresight to demand before he set out.

In a second voyage made in 1493, he discovered San Domingo, Guadaloupe, and Jamaica, explored Cuba, and commenced the colonization of these islands. Being obliged, as admiral, to settle some disputes among his Spanish colonists, the seeds of a violent hatred were sown which ripened during a third expedition made in 1498. During this last voyage he discovered and explored the coast of South America, near the Orinoco river. He increased the number of military posts, quelled a rising sedition, and sent back to Spain some of the malcontents. They, by their calumnies, gave weight to the accusations already made against him for severity and incompetence. As Spain began to need him less, she commenced to regret having invested a man of obscure birth, and a stranger, with such great powers and brilliant privileges. The Court ordered an investigation, which was entrusted to Bobadilla, a violent and ambitious man, who, on arriving in the new world, without a hearing placed Columbus and his two brothers in chains, and sent them to Spain. Ferdinand and Isabella disapproved of this unworthy treatment of a man who had done so much for them, struck off the chains, and promised him his command. Bobadilla was recalled, but perished in a storm at sea. Instead now of again bestowing the command on Columbus, one Ovando was appointed interim-governor for two years, while Columbus had only the remembrance of the chains as a recompense for his services.

Through solicitation at Court, and the influence of friends, a third expedition was fitted out for him in 1502, but the viceroyalty was not restored, nor was he to land at San Domingo. This, his last voyage, was a long series of disasters. He explored Cuba anew, discovered Cape Honduras, but was nearly wrecked in a dreadful tempest, and was obliged to lay by in a harbour of Jamaica to recruit. Suffering from privation and sickness, and obliged to be on the alert against mutinies and treachery among the sailors, denied all help by Ovando, it was nearly a year before he could set sail to return. In November, 1504, he dropped anchor in San Lucar. Isabella had died shortly before, and, without a friend at Court, he found himself coldly received by Ferdinand. Poor and sick, he lingered two years, vainly waiting for justice to be done him, and expired at Seville in May 1506, ignorant to the last that he had discovered a new world to which one of his companions would afterwards give, not the name of Columbus, the discoverer, but his own.

C O L U M B U S

CHRONOLOGY OF HIS LIFE



1436	BORN AT GENOA.		
1460	FIRST WENT TO SEA	AGE	24
1470	SETTLED IN LISBON; MARRIED	„	34
1474	CORRESPONDED WITH TOSCANELLI	„	38
1477	SAILED BEYOND ICELAND	„	41
1484	DISCUSSED PROJECT WITH GARCIA FERNANDEZ	„	48
1489	SERVED AGAINST THE MOORS AT BAZA	„	53
1491	UNFAVOURABLE REPORT OF COMMITTEE ON HIS SCHEME	„	55
1492	OBTAINED SANCTION OF FERDINAND AND ISABELLA; SET SAIL AUGUST, REACHED SAN SALVADOR OCTOBER	„	56
1493	EMBARKED ON SECOND VOYAGE FROM CADIZ	„	57
1496	RETURNED	„	60
1498	EMBARKED ON THIRD VOYAGE	„	62
1501	BROUGHT HOME IN CHAINS	„	65
1502	EMBARKED ON FOURTH VOYAGE	„	66
1504	RETURNED	„	68
1506	DIED AT VALLADOLID	„	70





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PALISSY

PALISSY

1510-1590

INDUSTRIAL ART

BERNARD PALISSY, the Huguenot potter and naturalist, was born, 1510, at La Capelle-Biron. His father was a tile-maker, or worker in clay. Palissy was apprenticed to a glass-stainer at Agen, whose art he soon learned, and acquiring a knowledge of drawing, became expert in painting heads and portraits on glass. He also applied himself to learning surveying and the drawing of plans. When he had acquired some proficiency in these branches of industry, he set out to make the tour of France, as was the custom among artisans of that time, and between 1525 and 1530 he visited all the principal districts of France, extending his travels also to Flanders and the Low Countries, living by the products of his two trades of glass-painting and land-surveying. He seemed to have the natural genius of the observer and ruralist. Nothing which could furnish matter for serious thought escaped his observation, and in after years his writings show the surprising extent and variety of information gathered during these years of travel.

In 1535 he settled permanently at Saintes, and four years later married. His trade of glass-painter gave him but a pittance. He was restless and constantly experimenting. A small cup of Italian majolica

falling into his hands, he set himself to find out the secret of making glaze, enamelled ware being at that time unknown to French industry. If he could make such cups as this he thought he should obtain both wealth and fame. His means were too small at first to enable him to arrive at any result. In 1543 his resources were considerably augmented by his being appointed to survey the salt-marshes of Saintonge, and this work finished, he began anew to prosecute his researches. After many trials he succeeded in producing crude white enamel, which, though not the supreme object of his search, gave him hope of obtaining the cherished result. The story of his struggles, his poverty, the contempt of friends and neighbours, the cries and upbraidings of wife and children, have been too often told at length to be more than mentioned. It is sufficient to know that sixteen years had elapsed since he first entertained the idea before the final triumph came, and he was able to produce in all their perfection of colour the works of art which had been ever present in his imagination. He now made vases, statuettes, dishes, plates, and divers utensils, ornamented in relief, richly coloured, and highly enamelled, which he called rustic figulines.

Thus was invented the Palissy ware, those admirable pieces of faïence on which are grouped reptiles, fishes, shells, and all manner of rural objects, which in their fine modelling and grouping show Palissy's intimate acquaintance with nature, as well as the peculiar individuality of the self-taught sculptor. His works found a ready sale. The Duke of Montmorency became his patron, and ordered him to make decorations for his château at Ecouen. Other seigneurs followed the example, and good fortune now began to make up for the trials and struggles of former years.

It was at this time, 1559, that religious troubles appeared in France. About 1546 Palissy, with all his family, had embraced the new ideas of Luther and Calvin, and contributed much toward the foundation of a reformed church at Saintes, and it was not to be supposed that he could escape the rigours of persecution. He was denounced to the authorities, incarcerated at Bordeaux, and it required the intervention of Montmorency, aided by Catherine de Medici, to save his life. The ingenious inventor of rustic figulines must not become a sacrifice to religious contention: so a stratagem was resorted to that clemency might be shown without opposition to the edict. By the intercession of Catherine he was named inventor of rustic figulines to the king, and by this became only answerable

to the grand council. By means of these powerful friends he escaped the jurisdiction of the parliament at Bordeaux, and came to Paris soon after, being charged with the decoration of the royal gardens of the Tuileries, in which work he associated with him his two sons Nicolas and Mathurin.

During many years he lived at Paris, sheltered and protected by royalty, escaping the horrors of the Massacre of St. Bartholomew, and giving his leisure, not only to his artistic employments, but to the study of chemistry, geology, and natural history, for all of which he had a special genius. In 1575 the "Huguenot Potter" began a course of public lectures, to which he called all the learned doctors of the capital, to assemble and hear in three lessons the exposition of his theories on natural history; these discourses became so popular they were continued fifteen years. French science owes a debt to Palissy; he was the first in France to substitute for the vain explanations of the philosophers, positive facts and rigorous demonstrations. M. Hoefer, in his '*Histoire de la Chimie*,' has remarked that Francis Bacon was still a child when Palissy was publicly teaching at Paris that to obtain the truth it is necessary to have recourse to experience. Palissy did for chemistry what Bacon did for science in general, pointed out its true method. Many of Palissy's observations are beyond the teaching of his time. His classification of salts is still regarded as exact, and he was the first to establish a rational theory of crystallization.

The hate of the theologians, excited no doubt by his scientific opinions, revealed itself all at once in the midst of the comfort which he was enjoying. In 1588 the royal family could shelter him no longer; he was arrested as being a Protestant and sent to the Bastille. So strong was popular feeling, that the king himself, though he visited him in person, was not powerful enough to effect his release, and he died in his confinement, 1590.

Palissy is an original genius; like Rabelais, Cellini, and Leonardo da Vinci, a characteristic product of the Renaissance. His life, aims, and opinions are well worth the study of those who are seeking for new ideas. Like Franklin, he is the highest possible example for the self-made man, and, like him, a money success was but the stepping-stone to a higher life.

It is as a practical man, however, and not as a man of science, that the world is indebted to Palissy. A few words on his writings from the admirable little work of Professor Morley may here be subjoined: "The book which Palissy, after his rescue from prison, busied himself in seeing through

the press, contained treatises on four subjects, namely, agriculture, natural history, the plan of a delectable garden, and the plan of a fortified town which might serve as a refuge in those times of trouble. The book into which they are collected is thus entitled, 'A Trustworthy Receipt, by which all the men of France may learn how to multiply and augment their Treasures. *Item*.—Those who have acquired no knowledge of letters may learn a philosophy necessary to all dwellers in the earth. *Item*.—In this book is contained the design of a garden, as delightful and useful in invention as ever has been seen. *Item*.—The design and arrangement of a fortified town, the most impregnable of which men have ever heard.'

In a book published fourteen years later are embodied the results of his matured experience, and the whole sum of his acquirements as a naturalist who had pushed forward far beyond the knowledge of his time. "In this book," says Morley, "we find Bernard writing in the simplicity of an unlettered man, whom God has gifted with a quick and subtle genius, who, with the perfect mind of a philosopher, and fearlessness of manly thought and speech, is naïve and single-hearted as a little child."

"In an epistle to his patron, Montmorency, he urges upon him the duty of instructing his unlettered labourers, 'that they may be made carefully to study in natural philosophy according to my counsel. Especially let that secret and precept which concerns manure-heaps, that I have put into this book, be divulged and made manifest to them; and that also so long as may be needed, till they hold it in as high esteem as the thing merits. Since no man could estimate how great the profit in France would be if on this subject they would accept my counsel.' He then mentions a kind of earth called marl, used as manure in certain parts of Gascony and other parts of France, which subject he promises to investigate and treat of in a third book, 'if I see that my writings are not despised, and that they are put in execution.'

"Finally, Palissy commends to all his readers agriculture as 'a just toil, and worthy to be prized and honoured,' and again urges his desire that the simple may be instructed by the wise, in order that we may none of us be rebuked at the last day for having hidden talents in the earth.' With this last thought, couched in the most solemn form of adjuration, Palissy ends as he began his series of prefatory letters."

PALISSY CHRONOLOGY OF HIS LIFE



1510	BORN AT LA CAPELLE-BIRON.		
1528	SET OUT ON HIS TRAVELS	AGE	18
1535	SETTLED AT SAINTES	„	25
1538	FIRST EXPERIMENTS ON ENAMEL	„	28
1543	APPOINTED TO SURVEY SALT MARSHES OF SAINT- ONGE	„	33
1546	EMBRACED PROTESTANT RELIGION	„	36
1554	RESULT OBTAINED	„	44
1562	IMPRISONED AT BORDEAUX FOR HIS RELIGION	„	52
1575	BEGAN COURSE OF PUBLIC LECTURES IN PARIS	„	65
1580	‘DISCOURSE ON WATERS AND FOUNTAINS’	„	70
1588	IMPRISONED AT THE BASTILLE	„	78
1590	DIED IN BASTILLE	„	80



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FRANKLIN

FRANKLIN

1706-1790

ELECTRICITY

As in the world generally, so among the acknowledged great, there are recognised grades. Even in the 'Hundred Greatest Men' there is a hierarchy. Instinctively in the highest rank we put those *who see more than other men*—Aristotle, Shakespeare, Cæsar, Frederick. To the second rank belong men of narrower minds, who, having a strong bent in one direction, achieve great eminence as by inspiration, unconscious workers—Francis of Assisi, Cromwell, Luther. In the third rank are the original geniuses, who, struggling against too great odds, have left behind them many suggestions, but no perfect work: such are Palissy, Diderot, Burns. Finally, there are men not great in themselves but only so from the position they occupy—a statue tall because of its pedestal: such are Plutarch, Gutenberg, &c.

While England has produced several men of the first rank—Bacon in Philosophy, Shakespeare in Poetry, Newton in Science—America has produced one. Franklin is for Industry—that is, for Invention, Discovery and Philanthropy—what these are for their special departments.

Franklin was born in Boston, Massachusetts, in 1706, where his father, a Nonconformist from Northamptonshire, had settled twenty-five years before. He was the youngest of ten children, and at an early age showed

such a fondness for books that it was determined to educate him for the ministry. After two years at school, however, he was obliged to leave and assist his father, who with his trade of dyer combined that of tallow-chandler and soap-boiler. Benjamin, though disliking this kind of occupation, worked at it two years, and in his twelfth year thought himself decidedly fortunate in being apprenticed to his brother, a printer, a business which promised to afford better opportunities to get at books, his one special desire. Among all the books he had read, voyages and history charmed him most; but he tells us in his autobiography that the two works which exercised the greatest influence on his career were the 'Lives of Plutarch' and the 'Essay on Projects' by Defoe, the author of 'Robinson Crusoe,' read about this time.

In the business of printing he soon became an expert, read with avidity all the books that came within his reach, and tried his hand at verse-making. But falling in with some old volumes of the 'Spectator,' he became more interested in forming his prose style on the model of its articles; and, as he says, was thus prevented from becoming a bad poet. At the age of sixteen he had read Locke 'On the Understanding,' the 'Art of Thinking,' of Port-Royal, and Xenophon's 'Memoirs of Socrates.' Every new faculty which in turn developed itself in him was almost always carried to exaggeration from having no guide to direct its applications. The study of Metaphysics made him sceptical, and to defend his new principles he adopted the Socratic method of reasoning, in which he became an adept.

About this time his relations with his brother became unpleasant. He was evidently too smart. Original articles written by him were accepted for publication in his brother's paper, the editor not knowing their source. The brother became jealous, and although his indentures were not out, Franklin determined to leave him and start in the world for himself. He sold some of his books and quietly left Boston in October, 1723, being then seventeen years old. He landed in Philadelphia, unknown and friendless, but soon found employment with a printer, a Jew, to whom he rendered himself invaluable by his skill, energy, and fruitful resources for obtaining orders. He received flattering attentions from some of the prominent citizens there, and attracted the attention of Keith, the governor of the province, who greatly patronised him, and proposed to set him up in business for himself. Franklin embarked for London to buy the necessary type. On arriving there he found he had relied too confidently on promises which could not be fulfilled, and must depend on his own exertions to gain

even his daily bread. He found employment at a famous printing-house—Palmers, and afterwards at another, staying in London eighteen months. He made friends among his fellow-workmen, set them an excellent example of temperance and good work, and astonished them by his feats of swimming. He wrote at this time some essays, a ‘Dissertation on Liberty and Necessity, Pleasure and Pain,’ which were printed and circulated.

He returned in 1726 to America, and after a few months established himself in the printing business with a man named Meredith, who after a short time retired, leaving Franklin sole proprietor. Now began in earnest the business of life; let any young man who wishes a Guide to Success read Franklin’s autobiography from this point: of his patience, his industry, his virtue, his shrewdness—how he wheeled home his own paper—how he started the *Gazette* and ‘Poor Richard’s Almanac,’ distanced all competitors, got the State printing, and made money. Read next how he won the confidence of the citizens and turned it to their own advantage; how he organised the first police force and fire company in the colonies, and took those steps which resulted in the foundation of the University of Pennsylvania and the American Philosophical Society; “in fact, he furnished the impulse to nearly every measure or project which contemplated the welfare and prosperity of the city in which he lived.”

At this time, during all these miscellaneous avocations, his own development went steadily on. A moral philosopher he had always been; he now became a natural philosopher. Fire in all its forms had always had a special attraction for him: he made many experiments and several inventions, and at last the great discovery with which his name is ever associated—the identity of lightning and electricity. “Since the introduction of the art of printing,” says Bigelow, “it would be difficult to name any discovery that has exerted a more important influence on the industries and habits of mankind.” The name of Franklin is identified with electricity as the name of Watt is with that of steam, and this is his highest achievement.

In 1754, in view of a war between France and England, Franklin was foremost in submitting plans for the defence of the colonists, which not being accepted by the mother-country, he was appointed to carry a petition from the colonies to England. This was the beginning of his diplomatic career, and “the success of this foreign mission,” we are told, “was both substantial and satisfactory.” He resided in and about London five years, upholding the interests of the American colonies, and making

many friends in and outside of political circles. Hume, Robertson, and Adam Smith were the friends most prized by him.

In 1764 Franklin was again sent to England to remonstrate against the grievances imposed by the mother-country, and he did not return till the struggle had begun, and he was satisfied further diplomacy could avail nothing. The very morning of his arrival in Philadelphia he was elected delegate to the Continental Congress; later was made postmaster-general and commissioner to Canada. He was one of the five who drew up the "Declaration of Independence," and in 1776 was unanimously chosen one of the three to represent the cause of the colonies at the court of Louis XVI., and solicit aid from France.

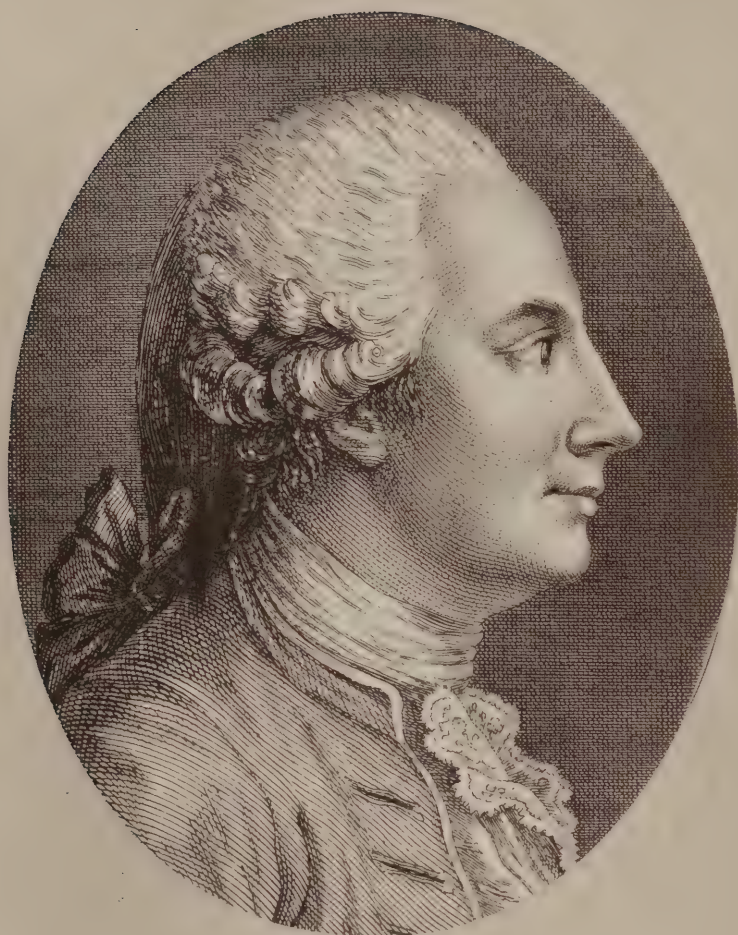
He was now seventy years of age, one of the most noted men in the world, a member of all the learned societies of Europe, and an accomplished statesman. "To these advantages he added a political purpose—the dismemberment of the British empire—which was entirely congenial to every citizen of France." The story of his mission to France as told by himself is singularly interesting. He at once became the object of the most intense interest, which during a stay of eight years seemed ever on the increase. While in Paris he wrote much for the press, and "kept the world constantly talking of him, and wondering at the inexhaustible variety and unconventional novelty of his resources."

In 1785 the definite treaty of peace was signed, and Franklin solicited permission to return home, which was granted. His reception in Philadelphia, where sixty-two years before he had landed a "penniless, runaway apprentice of seventeen," almost exceeded the bounds of enthusiasm. The appreciation of a grateful people was still further expressed when a month later he was elected chairman of the municipal council, and in 1787 member of the convention which framed the constitution for the new Republic, and to the joint efforts of Franklin and Washington must the final adoption of the constitution framed by this convention be ascribed. After being three years President of Pennsylvania, he retired from active life, using his pen, however, as vigorously as ever. In 1790, in the eighty-fifth year of his age, he died in Philadelphia.

"America," says Bigelow, "owes much to him for his services in various public capacities; the world owes much to the fruits of his pen; but his greatest contribution to the welfare of mankind, probably, was what he did by his example and life to dignify manual labour."

—○—●—○—

1706	BORN AT BOSTON.								
1717	APPRENTICED TO HIS BROTHER	.	.	.	.	.	.	AGE	11
1723	WENT TO PHILADELPHIA	.	.	.	.	.	.	„	17
1725	IN ENGLAND	.	.	.	.	.	.	„	19
1730	MARRIED IN PHILADELPHIA	.	.	.	.	.	.	„	24
1732-57	‘POOR RICHARD'S ALMANACK’	.	.	.	.	.	.	„	26-51
1744	FOUNDED UNIVERSITY OF PENNSYLVANIA	.	.	.	.	.	.	„	38
1746	BEGAN INVESTIGATIONS IN ELECTRICITY	.	.	.	.	.	.	„	40
1750	DEPUTY TO GENERAL ASSEMBLY	.	.	.	.	.	.	„	44
1752	DISCOVERED IDENTITY OF LIGHTNING AND ELECTRICITY	.	.	.	.	.	.	„	46
1753	POSTMASTER-GENERAL	.	.	.	.	.	.	„	47
1757-62	ENVOY TO ENGLAND	.	.	.	.	.	.	„	51-56
1764-75	„ „ „ F.R.S.	.	.	.	.	.	.	„	58-69
1776	SIGNED DECLARATION OF INDEPENDENCE; EMBASSADOR TO FRANCE TILL 1785	.	.	.	.	.	.	„	70-79
1778	CONCLUDED TREATY OF ALLIANCE WITH FRANCE	.	.	.	.	.	.	„	72
1785	GOVERNOR OF PENNSYLVANIA	.	.	.	.	.	.	„	79
1787	DELEGATE TO CONVENTION FOR REVISING ARTICLES OF UNION	„	81
1790	DIED AT PHILADELPHIA	„	84



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MONTGOLFER

MONTGOLFIER

1740-1810

AEROSTATION

SHALL we ever fly? Is man or the bird the superior creature? The question is not as easy as it seems; like most others, it has two sides. The man who has done most to turn the scale practically in favour of humanity is the inventor of the balloon. We cannot say that he has wholly succeeded; probably the principle is wrong. A flying vehicle to traverse the air must not be a frail globe at the mercy of the winds, but a strong machine capable of overcoming them; the air yet awaits its Stephenson. Nevertheless, the first stage is passed; the art of aerostation is founded, and to the founder we must erect a statue.

Joseph Montgolfier was born at Vidalon-les-Annonay, where his father owned a paper manufactory. He was placed with his two brothers at school at Tournon, but could not apply himself, and ran away at the age of thirteen, determined to gain the shores of the Mediterranean. He was brought back and placed once more under the teachers, who laboured hard to overcome his dislike for study, which increased, however, when a theological course was proposed to him; but he was "transported with joy" when a treatise on arithmetic was put into his hands; yet still incapable of

subjecting his mind to the methodical deductions of the book, he began applying certain intellectual experiments, quite original, to combine particular formulas of his own, by the aid of which he managed not only to work out the sums, but to resolve even the problems of the higher mathematics. Intellectual experiments of this kind were his delight throughout his life.

Greatly longing for independence, he quitted his native town for St.-Étienne, in Forez, where he lived, in obscurity, by the product of fishing and the sale of chemicals, prussian blue and various salts which he knew how to compound. The desire to become acquainted with the savants of Paris conducted him to that city, and later we find him seeking their acquaintance at the Café Procope.

His father recalled him, however, to take part in the direction of the manufactory; but the youth was not satisfied with the old ways, and wanted to try to perfect the paper-making process by experiment. As his father objected, he associated with him one of his brothers, and formed two new establishments at Voiron and Beaujeu. Here he could exercise his inventive faculties in all freedom; but his hazardous and expensive experiments soon ruined his fortune, though he had succeeded in simplifying the manufacture of ordinary paper, and improved that of coloured paper. He had also invented a method of stereotyping, and imagined a machine for rarefying the air in the moulds used in the manufactory, when his discoveries in aerostatics overshadowed everything else, and rendered his name European. Various anecdotes are told of the origin of the discovery. According to one, a garment warming before the fire and becoming inflated gave him the idea; another account gives the honour of the discovery to Étienne, a younger brother. While Joseph, the unruly scholar and hare-brained inventor, had been going the road of too many inventors, Étienne had distinguished himself in Latin and mathematics, had been a pupil of Soufflot, and turning also to Industry had made his own manufactory flourish and had become known as a clever man. Returning from Montpellier, where he had bought the book of Priestley's, "On the Different Kinds of Air," he entered his house exclaiming, "Now we can sail in the air." Others say that the grand idea came to him while watching the heated air ascending the chimney; while still another gives it again to Joseph, who, being an accidental witness to a siege, thought of a passage through the air as a possible entrance to the besieged place.

It is very probable that after reading Priestley, one of the brothers was struck with the idea of making something lighter than air to navigate it. The secret was shared between them; all the calculations were made in common. After many experiments of combustibles, hot air, inflammable gas, and "*fluide électrique*," being suggested, and after many trials, at first with paper globes and then with silk ones, they made at the Célestins, near Annonay, the first public trial with a paper globe, forty feet in diameter, filled with hot air. This exhibition took place in June, 1783. Étienne was then engaged by his brother to take to Paris the discovery, the glory of which was to be shared in common. The experiment of Annonay was repeated before the Court at Versailles in the same year, with a globe constructed on the same model. Some animals were placed in a basket attached to the balloon, and as they experienced nothing unpleasant in the ascension, it was thought that man himself could now take possession of the atmosphere without running any danger. Pilâtre de Rozier and the Marquis d'Arlandes were the first who trusted themselves to an aerial voyage, and in seventeen minutes found they had accomplished a distance of 24,000 feet.

The year following Joseph undertook personally to conduct an aerial excursion in a monster balloon over 100 feet in diameter. Such was the enthusiasm of those who wished to accompany him, that they came nearly to upholding their pretensions by force of arms. The fortunate ones mounted in the frail bark, called after its inventor a *Montgolfière*, "with the greatest courage," and the voyage was successfully accomplished.

The inventors, after having tried all the substances that chemistry indicated as specifically lighter than atmospheric air, after having tried water reduced to a state of vapour, hydrogen and *fluide électrique*, (?) succeeded best in inflating their balloon by means of burning straw and chopped wool as the most economical and easiest renewed. In their manner of operating, the warm air was introduced by means of a furnace placed underneath the orifice of the balloon. But from this arose two inconveniences: (1.) that the fire might possibly reach the sides of the balloon; (2.) it was impossible to measure exactly the amount of heat necessary to mount it, and the diminution necessary to descend without dangerous results. M. Charles, who had tried other ways than those employed by the Montgolfiers, used hydrogen gas, of which the density is only a fifth of common air, and which

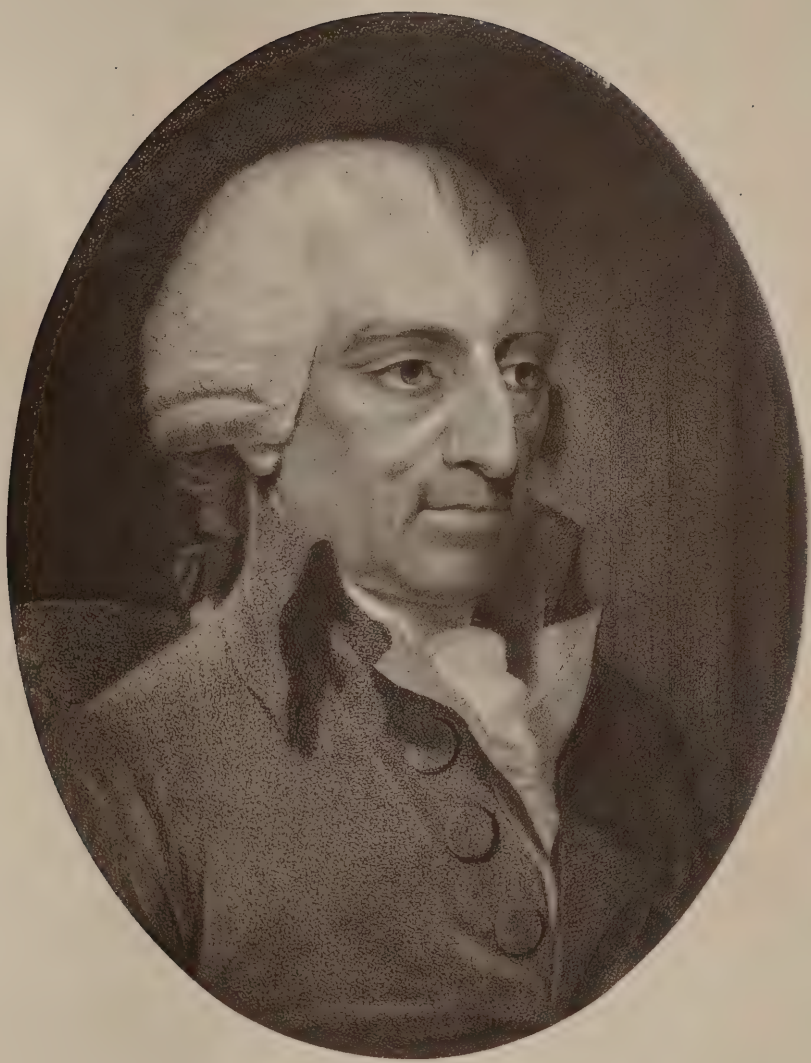
gives a sustained and independent ascending force. This same gas was afterwards adopted by Joseph Montgolfier, and then it only remained to find an impervious envelope; silk, varnished with india-rubber dissolved in turpentine, seemed the best adapted, and on these principles a balloon was made, which, starting from the Tuileries, made a voyage of forty miles from the capital.

At this time the enthusiasm with which this wonderful invention had been received somewhat abated, but the Academy of Sciences at Paris recognised its importance, and placed Joseph and Étienne on its list of correspondents, while the Government remitted to them the sum of 40,000 francs to continue their experiments. Étienne was received at Court, and decorated with the ribbon of St. Michel, the family received letters of nobility, and Joseph a pension of a thousand francs.

During the Revolution the two brothers lived in retirement, occupied in working out other mechanical ideas, and introducing further improvements in the manufacture of paper. To Joseph Montgolfier is due also the invention of the calorimeter and the principle of the hydraulic press, afterwards made practical by Bramah.

The services which the balloon of Montgolfier rendered to the French army in the field of Fleury did not attract the notice of Government; but later, when Bonaparte, as first Consul, was distributing the Cross of the Legion of Honour to the citizens who had contributed to the progress of national industry, Joseph received the decoration. Later he was named Administrator of the Arts and Trades, and he is identified with the founding of the "Society for the Encouragement of Industry." Of his writings, three are important: 'Discours sur l'aérostat,' 1783; 'Mémoire sur la Machine aérostatique,' 1784; 'Voyageurs aériens,' 1784.

He died in June, 1810, at Balaruc, where he had gone for his health.



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HOWARD

HOWARD

1726-1790

PHILANTHROPY

JOHN HOWARD, the philanthropist, was born at Enfield or Hackney, London. His father was an upholsterer and carpet-warehouseman, but had retired from active business. The boy Howard was a quiet, original kind of lad, endowed with a weak constitution, "not bright, not vigorous, not ambitious." He was brought up in the country, near Woburn in Bedfordshire, learned a little Latin, and something of natural philosophy and medicine, but devoted most of his efforts towards acquiring a knowledge of the modern languages. At sixteen he was apprenticed to a grocer in London, but the employment was distasteful to him, and his father dying soon after, he bought up his indentures, and set out to make the tour of France and Italy.

After an absence of two years, he returned, "speaking French like a native." He began studying medicine and meteorology, and lodged at Stoke Newington with an invalid lady, who, when he fell ill, so carefully nursed him, that on his recovery he married her, "believing that no other return for her motherly conduct was sufficient." After her death, in 1755, Howard set out to visit Lisbon, believing he could alleviate the misery resulting from the recent earthquake at that place. The frigate in which

he had taken a berth was captured by the French, and he was detained, together with others, as prisoner of war. "Howard's heart almost broke with indignation at the treatment of his gallant and unhappy countrymen;" and on his release he hastened to lay the affair before the Government, and was instrumental in getting an immediate exchange of prisoners.

He continued his scientific pursuits; was elected a Fellow of the Royal Society in 1756, and contributed three papers. Two years later he married again, and settled at Cardington, near Bedford, where he found a large field for his philanthropic labours. He built model cottages for his labourers, and established free schools; and, at the end of ten years' labour, the unwholesome, wretched village had become pretty, clean, and prosperous. His wife died in 1765, and he went abroad again; visiting Holland, Switzerland, and Italy. Coming home in 1773, he was elected to the office of Sheriff of Bedford. As soon as he entered on his duties, already aware that abuses existed, he commenced making searching inquiries into the English prison system, and found things everywhere so badly managed, that his "humane heart was astonished, his sense of right violated." He extended his investigations to neighbouring counties, and gradually all over Britain. "He discovered so many abuses in the management which imagination had never conceived, and so much suffering of which the general public knew nothing, and of which the law took no account, that he determined to devote to the examination of these wrongs, and the reform of these abuses, whatever time and money might be needful. The task cost him a fortune and the remaining years of his life."

His inquiries began to attract attention. He laid before the House of Commons a brief survey of the prison system, and being unsuccessful in obtaining a seat in Parliament, went abroad in 1775, gathering statistics in relation to the prisons of France, Austria, and the Netherlands. After returning to London, he published 'The State of Prisons in England and Wales,' which created a great sensation; the public interest was aroused; something must be done for reform. Howard was at hand: his information was placed at the service of the House of Commons, and, later, a bill was passed for building two penitentiaries in accordance with his plans. Howard had a new and valuable idea. Hitherto criminals had sat with folded hands; now they should be made to labour. Prison labour dates from Howard. Once more the indefatigable philanthropist went abroad, to glean

additional information on the subject ; this time visiting Norway, Sweden, Denmark, Russia, Poland, Spain, and Portugal.

He was now fifty-seven years old, and had travelled in his mission about 40,000 miles. In the spring of 1784 he retired to his estates at Cardington, and lived quietly and simply for about two years, occupied with private schemes of benevolence, and study. At the end of 1785 he determined to undertake a new mission of philanthropy, and study the causes and cure of the plague. He wished to begin by inspecting the lazarettos of Marseilles, but the French Government, annoyed at his revelations in regard to the Bastille, refused him a passport through France. By the help of a clever disguise, however, he accomplished his object, and visited all the principal lazarettos along the shores of the Mediterranean, and passed on to Turkey ; visited Constantinople, and arrived at Smyrna during the plague, and was afforded an excellent opportunity of studying it.

At the end of twelve months his documents were quite complete, and he ready to return home, when he was seized with the idea that his knowledge would be of more value if it were the result of experience, instead of being acquired from others ; and he determined to witness and study for himself the confinement in the famous lazaretto of Venice. Deliberately searching out at Smyrna a foul ship, he secured a berth, and sailed for Venice. On the sixtieth day of the voyage he arrived, and was transferred to the lazaretto, where his health suffered severely, but he was buoyed up by the thought of the precious information he was gaining for others. He reached England, February 1787, and took advantage of his leisure to revisit all the prisons of the three kingdoms, which he found much improved. This year he also published 'The Lazarettos of Europe' ; and in a postscript he informed the public of his intention to study the subject yet more. "To my country," he said, "I commit the result of my past labours. It is my intention again to quit it for the purpose of revisiting Russia, Turkey, and some other countries, and extending my tour into the East. I am not insensible of the dangers that must attend such a journey. Should it please God to cut off my life in the prosecution of this design, let not my conduct be imputed to rashness or enthusiasm, but to the serious conviction that I am pursuing the path of duty."

Starting from London, he went to Riga, then visited St. Petersburg and Moscow, intending to go through Vienna to Constantinople ; but the

war between Russia and Turkey prevented him: and in visiting the different centres of the war the question of the plague was even laid aside. Journeying down to the coasts of the Black Sea, he had reached Kherson, at the mouth of the Dnieper, when he caught the camp-fever, and died June 1790. He was buried on the road to St. Nicolas, a short distance from Kherson, and a monument has been erected to him in St. Paul's Cathedral.

HOWARD

CHRONOLOGY OF HIS LIFE



1726	BORN IN LONDON.		
1742	APPRENTICED TO A GROCER	AGE	16
1755	SET OUT FOR LISBON	„	29
1756	ELECTED MEMBER OF ROYAL SOCIETY	„	30
1758	SETTLED AT CARDINGTON	„	32
1765	VISITED HOLLAND, SWITZERLAND, ITALY	„	39
1773	ELECTED SHERIFF OF BEDFORD	„	47
1773-5	INVESTIGATED THE STATE OF ENGLISH PRISONS	„	47-49
1774	GAVE EVIDENCE BEFORE HOUSE OF COMMONS	„	48
1775	VISITED PRISONS ON THE CONTINENT	„	49
1777	‘STATE OF PRISONS IN ENGLAND AND WALES’	„	51
1785	VISITED CONSTANTINOPLE, SMYRNA	„	59
1787	‘LAZARETTOS OF EUROPE’	„	61
1790	DIED IN THE CRIMEA	„	64



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ARKWRIGHT

ARKWRIGHT

1732-1792

MACHINERY

COTTON MANUFACTURE

THE extraordinary individual to whom we are indebted for the great and signal invention of the Spinning Frame was a native of Preston in Lancashire. He was the youngest of thirteen children, and was bred to the trade of a barber. But the *res angusta domi* could not repress the native vigour of his mind, or extinguish the desire he felt to emerge from his low situation.

In 1760 he established himself at Bolton-le-Moors, and having become possessed of a chemical process for dyeing human hair, which in that day, when wigs were universal, was of considerable value, he travelled about collecting hair, and disposing of it again when dyed. It is unfortunate that very little is known of the steps by which he was led to those inventions that raised him to affluence, and have immortalised his name. Residing in a district where a considerable manufacture of linen goods and of linen and cotton mixed was carried on, he had ample opportunities of becoming acquainted with the various processes that were then in use; and being endowed with a most original and inventive genius, and having sagacity to perceive what was likely to prove the most advantageous pursuit in which

he could embark, his attention was naturally drawn to the employment of the method of spinning practised in his neighbourhood.

He stated that he accidentally derived the first hint of his great invention from seeing a red-hot iron bar elongated by being made to pass between rollers. Between this operation and that of elongating a thread, as is now practised in spinning, there is no mechanical analogy; yet this hint, being pursued, produced an invention which, in its consequences, has been a source of individual and national wealth unparalleled in the annals of the world.

The precise era of the discovery is not known, but it is most probable that the felicitous idea of spinning by rollers had occurred to his mind as early as the period when Hargraves was engaged in the invention of the spinning jenny. Not being himself a practical mechanic, Arkwright employed John Kay, a watchmaker at Warrington, to assist him in the preparation of the parts of his machine. His inventions being at last brought into a pretty advanced state, Arkwright, accompanied by Kay, and a Mr. Smalley of Preston, removed to Nottingham (1768) in order to avoid the attacks of the same lawless rabble that had driven Hargraves out of Lancashire. Here his operations were at first greatly fettered by a want of capital, but Mr. Strutt, of Derby, a gentleman largely engaged in the stocking manufacture, having seen Arkwright's inventions, and satisfied himself of their extraordinary value, immediately entered, conjointly with his partner, Mr. Need, into partnership with him. Arkwright then erected his first mill, which was driven by horses, at Nottingham, and took out a patent for spinning by rollers in 1769. As, however, the mode of working the machinery by horse-power was found too expensive, he built a second factory on a much larger scale at Cromford in Derbyshire in 1771, the machinery of which was turned by a water-mill, after the manner of the famous silk-mill erected by Sir Thomas Lombe.

Soon after the erection of this mill Arkwright made many improvements in the mode of preparing the cotton for spinning, and invented a variety of ingenious machines for effecting this purpose in the most correct and expeditious manner, for all of which he obtained a patent in 1775, and thus completed a series of machines so various and complicated, yet so admirably combined and well adapted to produce the intended effect, as to excite the admiration of every person capable of appreciating the

difficulties of the undertaking. The vast importance of the discoveries for which Arkwright had taken out patents became very speedily known, and it is not surprising that every effort should have been made in the courts of law to have them set aside, and Arkwright deprived of the profit and honour to be derived from them. Eventually his patent was nullified in 1781. It would seem, however, that there are no good grounds for the statement made in the Court of King's Bench, and afterwards repeated by Mr. Guest in his 'History of the Cotton Manufacture,' which ascribes the invention of spinning by rollers to a man named Highs or Hayes, from whom Arkwright is said to have learnt it.

On their first introduction Arkwright's machines were regarded by the lower classes as even more adverse to their interest than those of Hargraves, and reiterated attacks were made on the factories built for them. But however extraordinary it may appear, it was amongst the manufacturers that the greatest animosity existed against Sir Richard Arkwright; and it required all that prudence and sagacity for which he was so remarkable to enable him to triumph over the powerful combination that was formed against him. The disgraceful spirit of animosity which must, if it had proved successful, have proved as injurious to the interests of the manufacturers as to those of Sir Richard Arkwright, did not content itself with actions in the courts of law, but displayed itself in a still more striking and unjustifiable manner. It is a fact that a large factory erected by Sir Richard at Birkacre, near Chorley, in Lancashire, was destroyed by a mob collected from the adjacent country in the presence of a powerful body of police and military, without any one of the civil authorities requiring them to interfere to prevent so scandalous an outrage. Fortunately, not for himself only, but for his country and the world, every corner of which is benefited by his inventions, Sir Richard Arkwright triumphed over all opposition. The same ingenuity, skill, and good sense, which had originally enabled him to invent his machine and get it introduced, likewise enabled him to overcome the various combinations with which he had subsequently to contend. Notwithstanding the nullification of his patent, Arkwright continued his prosperous career. Wealth flowed upon him with a full stream from his judiciously managed concerns. For several years he fixed the price of cotton twist, all other spinners conforming to his prices. In 1786 he was nominated high sheriff of Derbyshire, and having presented an address of

congratulation from that county to the King on his escape from the attempt of Margaret Nicholson on his Majesty's life, Arkwright received the honour of knighthood.

When it is considered that for many years he was afflicted with a violent asthma, which was always extremely oppressive, and sometimes threatened immediately to terminate his existence, his great activity and exertion must excite astonishment. For some time previous to his death he was rendered incapable of continuing his usual pursuits by a complication of maladies which at last deprived him of life at the Rock House, Cromford, August 3, 1792.

No man ever better deserved his good fortune, or has a stronger claim on the gratitude of posterity than Sir Richard Arkwright. His inventions have opened a new and boundless field of employment; and while they have conferred infinitely more real benefit on his native country than she could have derived from the absolute dominion of Mexico and Peru, they have been universally productive of wealth and enjoyments.

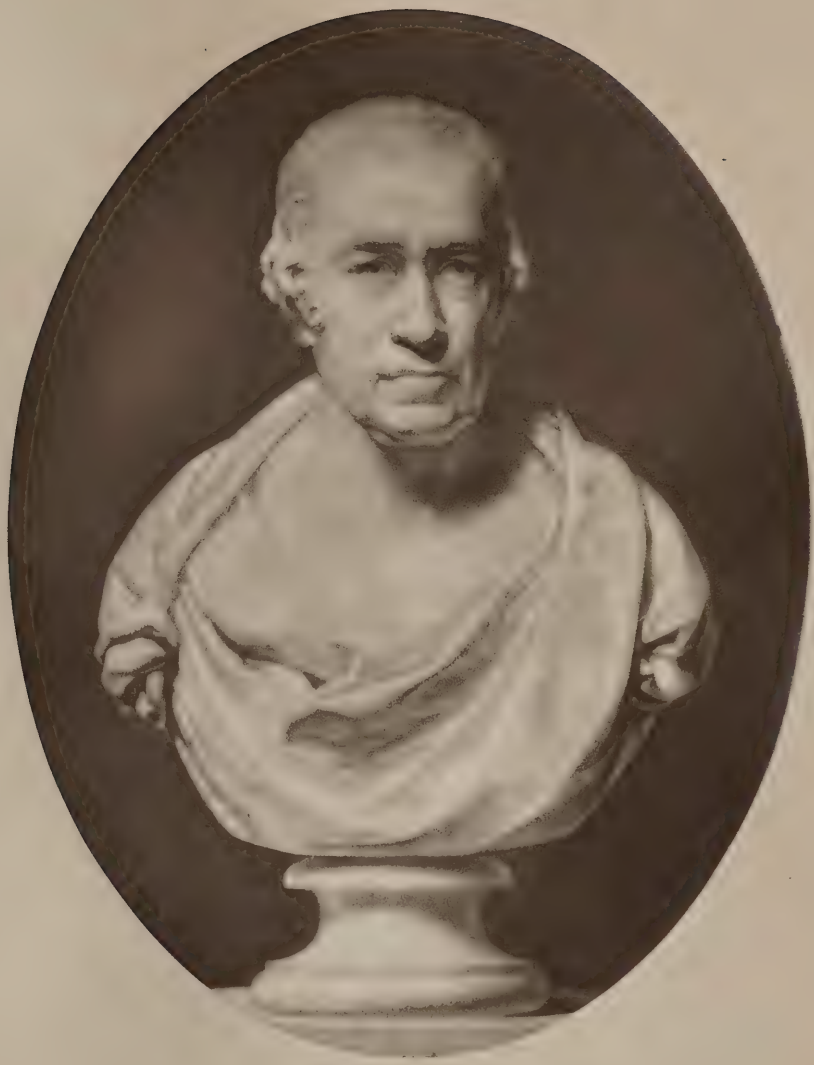
ARKWRIGHT

CHRONOLOGY OF HIS LIFE



1732	BORN AT PRESTON.		
1760	BARBER AT BOLTON WILLOWS	AGE	28
1767	CONSTRUCTED MODEL OF SPINNING MACHINE .	„	35
1769	OBTAINED PATENT; ERECTED MILL AT NOTTING- HAM	„	37
1771	MILL AT CROMFORD BUILT	„	39
1775	OBTAINED SECOND PATENT	„	43
1785	PATENT INVALIDATED	„	53
1786	MADE HIGH SHERIFF OF DERBYSHIRE AND KNIGHTED	„	54
1792	DIED AT CROMFORD	„	60





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WATT

JAMES WATT

1736-1819

STEAM

JAMES WATT was born at Greenock, on the Clyde, in Scotland, January 19, 1736. His parents were of the middle class, honest people with a character for probity which they had inherited from their ancestors. His grandfather was a teacher of mathematics in the village of Cartdyke, now part of Greenock, and dignified himself with the title of "Professor." His son James Watt, the father of the engineer, settled at Greenock as a carpenter and builder, and held office as town treasurer, and as bailie, or magistrate. Agnes Muirhead, the bailie's wife, and the mother of James Watt, was long remembered in the place as an intelligent woman, bountifully gifted with graces of person, as well as of mind and heart. Young Watt had for his first instructors his father and his mother, and in consequence of his fragile constitution his parents did not send him to the town school at a very early age. His very sports proved lessons to him. His mother, to amuse him, encouraged him to draw with a pencil upon paper, or with chalk upon the floor, and he was soon supplied with a few tools from the carpenter's shop, which he soon learnt to handle with considerable expertness. The mechanical dexterity he acquired was the foundation upon which he built

the speculations to which he owes his glory, nor without this mechanical training is there the least likelihood that he would have become the improver, and almost the creator of the steam-engine.

Several remarkable instances of precocity are related of Watt. On one occasion, when he was bending over a marble hearth, with a piece of chalk in his hand, a friend of his father said : " You ought to send that boy to a public school, and not allow him to trifle away his time at home." " Look how the boy is occupied," replied the father, " before you condemn him." Though only six years of age he was " trying to solve a problem in geometry." A still more wonderful story is told of the idle James watching the steam escaping from the tea-kettle. Let these pass for what they are worth ; Watt's tea-kettle may be placed along with the little hatchet of George Washington.

His early years were passed at Greenock, but from the age of fourteen he was often in Glasgow with his uncle Mr. Muirhead, and read and studied much on chemistry and anatomy. Having finished his education at the grammar school of his native town, he received no further instruction. As with all distinguished men, his extensive after-acquirements in science and literature were entirely the result of his own self-culture.

In his nineteenth year he came to London to place himself under a mathematical instrument maker, and after acquiring the knowledge of the profession which a year's instruction could afford him, he returned to Glasgow in 1757 with the intention of carrying on his business there. But he had not acquired the privileges of a burgess, and the Incorporation of Trades prohibited him from establishing a shop within the limits of the burgh. The University of Glasgow thus became the sanctuary of Watt, and the academical authorities, having found for him a shop within its walls, employed him in fitting up the instruments in the Macfarlane Observatory. In this hallowed retreat the exile from the burgh was patronised by Adam Smith, Joseph Black, Robert Simson, and John Robison, whose names are immortal in the scientific annals of Scotland. By his friend Robison the attention of Watt was first directed to the subject of the steam-engine. The College at Glasgow possessed a model of one of Newcomen's engines. Watt was much struck with the contrivance, but he soon perceived defects in it which prevented it from becoming more generally useful. From that time he devoted himself to the improvement of this machine, particularly

with regard to the saving of heat in the production and condensation of steam. At last his efforts were crowned with success, and he obtained a patent for his invention in 1769. Previously to this he had been joined by Dr. Roebuck, a gentleman of science and property, but their means were not adequate to their object. In these circumstances Mr. Boulton, becoming acquainted with Watt, made him an offer of partnership, which was accepted, Dr. Roebuck being reimbursed for what he had expended. Watt now removed to Soho, near Birmingham, where he was employed in the management of what is still one of the principal establishments in England for the construction of steam-engines. He became a Fellow of the Royal Societies of Edinburgh and London; a member of the Institute of France; and a Doctor of Laws of the University of Glasgow.

This truly great man may justly be placed at the head of those philosophers who have improved the condition of mankind by the application of science to the practical purposes of life. So great was the active power of his mind that he not only embraced the whole compass of science, but was deeply learned in many departments of literature. His manners were marked with the simplicity which generally characterises exalted merit, and were perfectly free from parade and affectation; and though he could not be unconscious of the eminent rank he held among men of science, yet his character was not debased by the slightest taint of vanity or pride.

He retired from business many years before his death, but his mind continued to be actively employed on scientific improvements. Having at length attained the age of 84, his life was terminated by an easy and tranquil death, on August 25, 1819, at his house at Heathfield, near Birmingham. His statue in marble, the masterpiece of Chantrey, is among the monuments which adorn the stately Abbey of Westminster.

The work done by Gutenberg and Columbus was the foundation of the great industrial impetus of the Renaissance. The work done by Franklin, and Arkwright, and Stephenson forms the foundation of the still greater industrial impetus of our time. It is this last movement which is the life of England, has created America, has revived France, Belgium and Italy, and may yet revive Spain and Greece.

W A T T

CHRONOLOGY OF HIS LIFE



1736	BORN AT GREENOCK.		
1755	CAME TO LONDON	AGE	19
1757	SETTLED AT GLASGOW	„	21
1758	BEGAN EXPERIMENTS ON STEAM	„	22
1769	OBTAINED PATENT FOR STEAM-ENGINE	„	33
1774	PARTNER OF BOULTON AT SOHO WORKS	„	38
1775	PATENT EXTENDED	„	39
1784	F.R.S.E.	„	48
1785	F.R.S.	„	49
1787	CORRESPONDING MEMBER OF BATAVIAN SOCIETY	„	51
1800	RETIRED FROM BUSINESS	„	64
1806	LL.D. AT GLASGOW	„	70
1808	CORRESPONDENT OF FRENCH INSTITUTE	„	72
1814	FOREIGN ASSOCIATE OF SCIENCES	„	78
1819	DIED AT HEATHFIELD.	„	83



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STEPHENSON

STEPHENSON

1781-1848

RAILWAYS

THIS self-taught genius was born of the most humble parentage, in a solitary cottage on the Tyne, between Wylam and Closehouse, Northumberland, about eight miles west of Newcastle. The wages earned by his father, who worked in a colliery, were barely sufficient, even with the most rigid economy, for the sustenance of the household, and consequently none of the children were sent to school. George began life as a cowboy, at twopence a day, but soon exchanged a pastoral for an agricultural sphere, doubling his wages by undertaking to hoe turnips. Then he was taken on at the colliery as a "corfbitter," or "picker," to clear the coal of stones, bats, and dross. His wages were advanced to sixpence a day, and to eightpence when he was set to draw the gin-horse. Great was his exultation when, at about fourteen years of age, he was appointed fireman at a shilling a day. From this point his fortunes took him from one pit to another, and procured him rising wages with his rising stature. At Throckley Bridge, when advanced to twelve shillings a week, he joyfully exclaimed, "I am now a made man for life!"

At seventeen he became an engineman or plugman. He soon studied

and mastered the working of his engine, and it became a sort of pet with him. He learnt that the wonderful engines of Watt and Boulton were to be found described in books, and with the object of mastering those books, though a grown man, he went to a night-school, at threepence a week, to learn his letters. For fourpence a week he included "figuring," while at the pit he acquired the art of brakeing an engine. When, as a brakesman, he made nearly £1 a week, he married Fanny Henderson, a pretty farm servant, who made him an excellent wife, and brought comfort as her dowry to the cottage which he took for her on Wellington Quay. At this time, during his leisure hours, he added to his income by making and mending the shoes of his fellow-workmen. Next he took to making shoe lasts, in which he was expert, and drove a good trade. From cleaning and repairing his own clock, he also became one of the most famous clock doctors in the neighbourhood. He was thus prospering and happy till calamity overtook him and he lost his wife. Soon afterwards he removed for an interval to Scotland. On his return he found his father reduced by an accident to blindness, and consequently to poverty, so he paid his father's debts cheerfully, undertook the support of him and of his mother, and discharged this filial duty towards them until their death.

In 1812 he was appointed enginewright at Killingworth, with a salary of £100 a year. Here he began his experiments with the locomotive. Wooden rails, it appears, were first laid down for the service of coalpits as early as 1602, and iron rails were afterwards used. The waggons were drawn by horses. From an early period Stephenson was quite sanguine as to the "travelling engine." He had inspected "Black Billy" and Blenkinsop's Leeds engine, and at length he brought the subject before Lord Ravensworth, the principal proprietor of the Killingworth colliery. His Lordship advanced money, and an engine was made which was accordingly called "My Lord." It was the most successful working engine that had yet been constructed, and succeeded in drawing thirty tons weight at four miles an hour. Still its economy was questionable, for it proved only that steam-power and horse-power were on a par in point of cost, while the speed of the engine was not beyond that of a horse's walk. At this point, however, Stephenson's genius turned the decision of the issue. The happy thought came to him to utilise the escaping steam by making it blow his fire. This invention of the steam-blast in the chimney

imparted velocity to the smoke, and so increased the ascending current of air that the power of the engine became more than doubled. He determined to make another engine, and this, which was constructed in 1815, was found to answer extremely well. Although many improvements in detail were afterwards introduced by George Stephenson himself, as well as by his equally distinguished son Robert, it is perhaps not too much to say that this engine, as a mechanical contrivance, contained the germ of all that has since been effected. It may, in fact, be regarded as the type of the present locomotive engine.

Stephenson was regarded as an enthusiast, and men shook their heads at his engine, predicting a "terrible blow up some day." He himself went so far as to say that it would supersede every other tractive power. At this period he began to direct his particular attention to the state of the Road, as he perceived that the extended use of the locomotive must necessarily depend in a great measure upon the perfect solidity, continuity, and smoothness of the way along which the engine travelled. Even then he was in the habit of regarding the road and the locomotive as one machine, speaking of the rail and the wheel as "man and wife."

Stephenson had no means of bringing his important invention prominently under the notice of the public. At length it attracted the attention of Mr. William James and Mr. Edward Pease. The former gentleman saw Stephenson's locomotive at Killingworth in 1821, and declared that it would effect a revolution in society. He expressed his belief that Stephenson was the greatest practical genius of the age, and truly predicted that his fame in the world would rank equal to that of Watt.

On the Darlington and Stockton Railway being sanctioned by Parliament, Stephenson was appointed the Company's engineer, at £300 per annum. The line was opened in 1825, and proved financially a success. When the railway between Liverpool and Manchester was projected, Stephenson underwent an examination, which lasted three days, before a Parliamentary Committee. One of the members asked whether, if a cow should stray on the line and get in front of the engine, that would not be a very awkward circumstance. "Yes," replied the witness, "very awkward indeed—for *the coo!*" At length authorisation was obtained, Stephenson became engineer-in-chief of the Company, and the works

were completed in 1829. At first it was intended to employ horses to draw the carriages, but the directors afterwards offered a premium of £500 for the best locomotive engine. In the competition which ensued the prize was won by Stephenson's famous engine the Rocket, which, during the trial trip, attained a maximum velocity of twenty-nine miles an hour. The problem of the locomotive engine was thus practically solved. The railway was opened in 1830, and the prosperity of the company proved the success of the new mode of travelling.

The subsequent career of Mr. Stephenson was as rapid and smooth as the railway locomotion he had done so much to realise. He took the lead at once in railway engineering, became an extensive locomotive manufacturer at Newcastle, and a railway contractor, a great colliery and iron-work owner, particularly at Claycross, and acquired great wealth. He was created a Knight of Leopold of Belgium; a Fellow of the Royal Society; and he was the founder and first president of the Society of Civil Engineers. His death occurred on the 12th of August, 1848, at Tapton House, near Chesterfield.

STEPHENSON

CHRONOLOGY OF HIS LIFE



1781	BORN AT WYLAM, NORTHUMBERLAND.		
1798	BECAME 'ENGINE-MAN'	AGE	17
1802	MARRIED	„	21
1804	LOST WIFE	„	23
1812	APPOINTED ENGINE-WRIGHT	„	31
1813	MADE LOCOMOTIVE STEAM-ENGINE AT KILLING- WORTH	„	32
1815	TOOK OUT PATENT; INVENTED SAFETY-LAMP	„	34
1819	MARRIED SECOND TIME	„	38
1825	STOCKTON AND DARLINGTON RAILWAY	„	44
1830	MANCHESTER AND LIVERPOOL RAILWAY	„	49
1845	VISITED BELGIUM AND SPAIN	„	64
1848	DIED AT TAPTON IN DERBYSHIRE	„	67

APPENDIX TO VOLUME VIII.

SOURCES OF THE PORTRAITS

GUTENBERG.

Fine line engraving issued in the Gutenberg Album. Für das Gutenbergs Album gestochen von Eduard Eichens in Berlin. Executed from an ancient print, and regarded authentic.

COLUMBUS.

Line engraving, Nargeo sculp. From painting attributed to Antonio del Rincon, said to be the only authentic portrait.

PALISSY.

From the picture in the National Collection, Cluny Museum. Marked upon the face B. Palissy. Fine lith. Hall Coll.

FRANKLIN.

Head of full-length portrait made during his sojourn in Paris. Portraits of Franklin are common. This one chosen on account of its beauty and rarity. L. C. de Carmontelle del. On the plate is inscribed "On l'a vu désarmer les Tirans et les Dieux."

MONTGOLFIER.

Line engraving by Binet. Le Beau sculp., marked Jos. de Montgolfier, chevalier de l'ordre de St. Michel, Inventeur d' l'Art Aërostatique.

ARKWRIGHT.

Engraved by T. Oldham Barlow, from the original picture by T. Gainsborough, R.A. In the Collection of Mr. B. Woodcroft. Great Seal Patent Office. Mezzotint. Artist's Proof. Signed in Pencil, Thos. Oldham Barlow.

HOWARD.

Stipple engraving in the older manner, from a painting by Mather Brown in possession of the family. Engraved by Edmund Scott, 1789. In the original he holds in his hand the plan of a lazaretto.

WATT.

Mezzotint engraving, from the bust by F. Chantrey, A.R.A. Engraved by S. W. Reynolds. Published 1825.

STEPHENSON.

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